NOTES ON OPHTHALMIC SURGERY,

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CATARACT—Central, Cortical, Lamellar, Capsular, Traumatic, Secondary. Operations. Spectacles.
CHOROID—Hyperæmia, Choroiditis, Sclerotico-Choroiditis Posterior, Tubercle, Tumors, Bone Formation, Coloboma, Rupture.
CILIARY REGION—Sympathetic Irritation, Sympathetic Ophthalmitis.
CONJUNCTIVA—Ophthalmia, Neonatorum, Gonorrhœal, Mucopurulent, Diphtheritic, Granular. Xerophthalmia. Pinguecala. Pterygium.
CORNEA—Local Keratitis, Ulceration, Hypopion, Onyx, Syphilitic Keratitis, Punctate Keratitis, Arcus Senilis, Pannus, Periotomy, Conical Cornea, Wounds.
EYELIDS—Blepharitis, Stye, Tarsal Tumor, Warts, Rodent Ulcer, Syphilitic Ulcer, Lupus, Nævus, Ptosis, Trichiasis, Symblepharon, Entropion, Ectropion.
GLAUCOMA—Acute, Chronic, Secondary.
IRIS—Iritis, Iridectomy, Iridotomy, Iridodesis, Prolapse, Coredialysis, Congenital Irideremia, Coloboma, Mydriasis, Myosis.
LACHRYMAL APPARATUS—Mucocele, Stricture of Nasal Duct, Fistula of Lachrymal Sac. Lachrymal Gland, Diseases of, Excision of.
OPTIC NERVE—Optic Neuritis, Atrophy.
RETINA—Retinitis, Syphilitic, Albuminuric, Apoplectic, Pigmented. Detachment. Glioma.
REFRACTION—Emmetropia, Ametropia, Presbyopia, Myopia, Hypermetropia, Astigmatism.
STRABISMUS—Internal, External, Operation.

Cataract is an opacity of the crystalline lens. Various classifications are used. The following is perhaps the best: (1) *Central;* (2) *Cortical;* (3) *Lamellar;* (4) *Capsular;* (5) *Traumatic;* (6) *Secondary.*

1. CENTRAL OR NUCLEAR.—Opacity begins at the centre and shades off toward circumference. It mostly occurs in old people, when it is hard at the centre and of amber color. When occurring before the age of thirty-five it is softer and whiter.

2. CORTICAL OR RADIATING.—Opacity begins at the surface of lens as triangular or pyramidal streaks pointing toward centre. When advanced they involve whole structure of lens.

3. LAMELLAR OR ZONULAR.—Opacity consists of a shell-like layer deposited within the substance of the lens at a variable distance from its surface. It occurs in very young subjects (1 to 3 months), and is sometimes congenital; the subjects of it frequently suffer from infantile convulsions.

4. CAPSULAR.—(*a*) *Pyramidal;* (*b*) *Posterior Polar.* (*a*) *Pyramidal.*—Occurs as a very white well-defined opacity on front part of lens just beneath the capsule. It is generally caused by ulcer of cornea following purulent ophthalmia, and, consequently, is generally associated with opacity of cornea. (*b*) *Posterior Polar.*—Begins at posterior part of chief axis of lens and radiates; generally associated with disease of choroid and vitreous.

5. TRAUMATIC.—Follows wound of the lens capsule by which the aqueous humor is admitted to the lens substance, causing swelling, opacity, and final absorption of this, and leaving only a chalk-like deposit upon the remaining capsule.

6. SECONDARY CATARACT is so called when it is the result of some other *local* disease, as glaucoma, irido-cyclitis, etc., or of some *general* disease, as diabetes mellitus.

Any combination of the above forms would be called a *mixed* cataract. The degree of hardness of a cataract depends chiefly upon the age of the patient, all cataracts occurring before the age of thirty-five being "soft."

Diagnosis.—Gradual failure of sight without local inflammatory symptoms is a subjective indication of cataract. A grayish appearance of the pupil is often observed in old people, which is not due to cataract, the lens being transparent. When the presence of cataract is suspected the pupil should be dilated by atropine and examined. (1) *By daylight,* diffused rays condensed upon the pupil with a convex lens. (2) *By gaslight* in a similar way. These will give a white, amber-like, or brownish appearance of lens. (3) *By the ophthalmoscope,* when the opacity of lens will appear as dark patches, streaks, or a central nucleus; the red choroidal reflex will only be observed inversely as the amount of opacity. In *lamellar cataract,* a well-defined shell of opacity appears, surrounded by a clear (cortical) layer of lens substance, through which the bright red choroidal reflex is observed. When any portion of the lens substance remains clear, note should be made as to the state of the vitreous, optic disc, retina, and choroid, with a view to probable fitness for future operation. *Opacities of cornea* will also appear as dark patches with ophthalmoscope, and may be seen by superficial examination. *Opacities of vitreous* appear as moving bodies, and are distinguished by their continuing to move after the patient's eye has suddenly come to rest.

Treatment.—In early stages of nuclear cataract the sight may often be improved by moderate dilatation of the pupil by atropine. Use atropine drops, gr. iv. ad ℥j., once or twice a week. Dark spectacles may be worn to favor dilatation of the pupil. In lamellar cataract patient can often

see fairly well. When vision is seriously impaired and the margin of translucency is *wide*, make an artificial pupil by iridectomy; when the margin is *narrow*, perform the operation of solution, or of extraction. In forms other than lamellar, sight can be restored only by one of the following methods of operating on the lens: (1) *Extraction;* (2) *Needle operation;* (3) *Suction.* (1) *Extraction.*—Various methods are in use at the present time, but all have the following common points: (1) An incision in the cornea or at the junction of the cornea and sclerotic, or in the sclerotic just beyond the cornea, sufficiently large to allow exit of lens. The incision is usually made with Von Graefe's straight knife. (2) Iridectomy is very frequently performed, either as a second stage of the operation or two or three weeks previously. This is done to lessen the danger of iritis, which more frequently follows the older operation in which iridectomy was not performed. (3) The capsule is freely ruptured by a sharp-pointed instrument introduced through the corneal wound. (4) The lens is removed through the torn capsule, either by pressure and manipulation outside the eye or by means of a scoop passed behind the lens. The chief types of operation for extraction are: (1) *Graefe's Modified Linear* or *Peripheral Linear.*—Here the incision is made with a long, narrow knife, slightly beyond the sclero-corneal junction, involving conjunctiva and forming a small arc of a circle larger than the cornea, the plane of incision forms a large angle with that of the iris. Iridectomy follows the incision. (2) The incision has nearly the same curve as the above, but is not carried so far toward sclerotic, being mostly in the cornea. Iridectomy is not usually performed here. (3) *Flap Operation* (old).—Incision just within margin of cornea, and concentric with it, equal to half its circumference, and parallel to plane of iris. Beer's triangular knife. No iridectomy. Disadvantages of modified linear operation: Frequent hemorrhage into anterior chamber. Greater risk of loss of vitreous. Risk of irritability from prolapse of iris into corners of wound, and of sympathetic ophthalmitis in the other eye. Disadvantages of the old flap operation: The large flap is liable to gape or fall forward, causing sloughing. Frequent prolapse of iris. Frequent severe iritis. *After-treatment* for either of these methods.—Keep the patient in bed for a week. Apply a piece of soft linen to the closed eyelids, and a pad of cotton wool over this to both eyes, and secure by a four-tailed bandage. Keep the room nearly dark. Remove dressing, and gently cleanse the lids with warm water twice daily, just separating their edges to allow escape of tears that may be retained. Use one drop of atropine solution daily after the third day to prevent iritic adhesion. During the first few hours there will be some soreness, and the first dressing a little blood-stained; after this there should be no pain, and only a little mucous discharge. If doing well there will be slight congestion, but no chemosis, edges of wound united, and pupil black. Discontinue bandage after eight or ten days, and order a large shade.

2. Needle Operation for Solution.—(1) Dilate pupil by atropine. (2) Give anæsthetic unless the patient is old enough to control himself well. (3) Hold lids open by stop-speculum, and use fixation forceps to steady globe. (4) Direct a fine cataract needle to a point just within the margin of the cornea, plunge freely and obliquely through into anterior chamber, and carry point to centre of pupil. (5) Dip point of needle back through the capsule into superficial layers of lens at centre, make a few gentle to and fro movements, so as to break up its substance, then steadily withdraw the needle. *After-treatment.*—Dilate the pupil with atropine (gr. iv. ad ℥ j.) three times daily. Bandage the eye lightly, and employ dark room for several days. In case of iritis apply leeches to region of eye, and ice or evaporating lotions to lids. The result varies with the amount of the opacity of the lens. In cases of complete cataract no marked change will be observed for some weeks after operation. In partial cataract the ruptured portion of the lens will become opaque and swollen in a few days, and in seven weeks the lens will be smaller. After six to eight weeks, if the eye be perfectly quiescent, and not otherwise, the operation may be repeated, and the needle used more freely. A third or fourth operation may be required.

3. Suction Operation.—Only applicable to soft cataract, and requires great skill in its performance, to avoid danger of iritis, or cyclitis. (1) Dilate pupil with atropine. (2) Make oblique opening in cornea with a broad-cutting needle between its centre and its margin, and lacerate capsule freely. (3) Withdraw needle and pass nozzle of syringe through wound, and dip into lacerated lens-substance. In lamellar cataract, and some other cases, it is necessary to allow an interval of three days between the needle operation and the suction, in order that the lens may be softened by the admission of the aqueous. (4) Use very gentle suction, and remove if possible the whole of lens-substance at one sitting. *After-treatment* is the same as for needle operation (but in the case of waiting, careful watch must be made, and suction performed *at once* if inflammation be set up by the rapid swelling of the lens).

When to Perform Extraction.—The more complete the opacity of the lens, the more easily is it shelled out of its capsule, whilst in immature cataract some of the transparent lens-substance is apt to remain; this will become opaque and may interfere with result of operation. The signs of this "ripe" condition are: (1) No shadow of iris thrown upon lens within the pupillary area; (2) no choroidal reflex with ophthalmoscope; (3) patient is able to distinguish light from darkness, but is unable to count fingers when held up before the eyes. When one eye only is affected, or when one is less affected than the other, extraction should be deferred until the better eye is no longer useful, unless for special reasons. When both cataracts are mature, only one *should be operated on at a time,* with an interval of a few months. When there is no percep-

tion of light do not operate, as cataract alone is not sufficient to prevent this.

Occasional Results of Extraction.—1. *Sloughing of cornea*, very rare since flap operation was abandoned. 2. *Suppurative inflammation* extending from wound to the whole cornea, iris, and vitreous, variable in degree, but, when established, generally going on to suppurative panophthalmitis, or to severe plastic irido-cyclitis with corneal opacity and contraction of eyeball. 3. *Iritis* of a plastic nature which deposits a membrane in pupillary area. 4. *Prolapse of iris* into the wound, either at the time of operation or afterward.

Conditions of Sight after Operation.—Results are good when, with the aid of proper spectacles, patient can read any of Snellen's test types from No. 1 to No. 14 at 22 centimetres (8 inches), and from No. 6 to No. 24 at 6 metres (20 feet). The operation renders the eye very hypermetropic for want of the lens. Very strong convex glasses are required to compensate for its absence. Glasses should not be worn for three months after operation, and then not continuously at first. Two pairs of spectacles are needed, one pair making the eye emmetropic and giving clear vision for distant objects (about + 12 dioptres), the other pair stronger, to render the eye myopic, so that the patient is able to read, etc., at about 8 or 10 inches (about + 16 dioptres).

Choroid. — Diseases. — 1, *Hyperæmia;* 2, *Choroiditis;* 3, *Sclerotico-choroiditis Posterior;* 4, *Tubercle;* 5, *Tumors;* 6, *Bone Formation;* 7, *Coloboma;* 8, *Rupture.*

Choroiditis may be (1) *Syphilitic*, (2) *Simple*, (3) *Suppurative.*

Syphilitic Choroiditis is the most common. It is characterized by the presence of numerous distinct patches scattered about fundus, but most abundant toward periphery; they are at first of a yellowish red appearance, which soon changes to yellowish white or glistening white, according to the extent of choroidal atrophy. The patches are more or less pigmented. Vision is affected in proportion to the extent of the disease. Usually no pain. Generally a history of acquired or inherited syphilis. *Treatment.*—Mercury combined with iodide of potassium. Rest of eyes by means of dark room. Artificial leech or dry cupping to temples. In the early stage mercury does great good, and in old cases where failure of sight is increasing it should be given. *Prognosis*, guarded.

Simple Choroiditis.—In this form the patches of atrophy are similarly distributed but are confluent (compare with syphilitic form). Or, large areas of incomplete atrophy are interspersed with separate patches, or there may be a widespread superficial atrophy with pigmentation. The field of vision is here also affected in proportion to the change.

Suppurative Choroiditis is acute, and occurs in conjunction with similar inflammation of neighboring parts (panophthalmitis).

Sclerotico-choroiditis Posterior is limited to the regions of the optic

disc and yellow spot, which present many varieties of localized change. It is common in myopic eyes, and the appearances thus produced are known as "posterior staphyloma," "myopic crescent," etc.

Tubercle of Choroid appears in the form of small circular, circumscribed spots (0.3 to 2.5 mm.), situated chiefly in the region of optic disc.

Tumors.—1, Sarcoma; 2, Carcinoma.

Bone Formation sometimes occurs on the inner surface of choroid of eyes which have been long destroyed; it varies in thickness from a mere film to a dense osseous cup.

Rupture of Choroid may occur from a blow on the globe and may exist with or without rupture of other coats. Hemorrhage at once occurs, and blood may be effused (1) between choroid and retina; (2) between choroid and sclerotic; (3) into vitreous.

Ciliary Region.—Sympathetic Irritation and Sympathetic Ophthalmitis.—In sympathetic irritation the changes in the sympathizing eye are chiefly functional. In sympathetic ophthalmitis they are of a destructive inflammatory kind.

Pathology.—The exact mode of transmission from the exciting to the sympathizing eye is not well known. Very interesting facts are known.

1. The change commences in the region of the ciliary body and iris of the exciting eye, and its effects are mostly seen in the corresponding part of the sympathizing eye. This region is richly supplied by branches of ciliary nerves (fifth, sympathetic, and third).

2. In exciting eye inflammatory changes are always found, and in some cases have been found to extend to the ciliary nerves. It is considered probable that the disease passes along the ciliary nerves, probably as neuritis, to some nerve-centre, and thence to the other eye.

3. The optic nerve is considered to have no part in the transmission of the inflammation; but the space between the dural and pial sheaths of the optic nerve is a probable channel of communication.

Symptoms in Sympathizing Eye.—1. *Irritation.*—Eye extremely weak and irritable; patient may be able to read No. 1 of Snellen's type, but soon becomes tired, because the power of prolonged accommodation fails. Eye sometimes reddened, may be watery; neuralgic pains common. Iris not affected. *No plastic exudation nor disorganizing changes take place.* Liable to recur. Excision of exciting eye at once cures the disease.

2. *Ophthalmitis.*—Begins from one to three months, or more, after affection of exciting eye. May be ushered in by irritation. May be well marked from the first, or may commence in a manner so insidious as to escape notice. It consists chiefly of irido-cyclitis or irido-choroiditis, the iritis evincing a tendency to the formation of tough and extensive synechiæ. There is a zone of ciliary congestion. Thickening and muddy appearance of iris. Tendency to formation of dots of opacity (keratitis punctata) on the posterior layer of the cornea. The vitreous, when the

condition of the pupil allows it to be seen, presents floating opacities. There may be neuro-retinitis. Tension of globe often increased. In the mildest forms of the disease there may be only slight serous iritis. In severe cases the eye either shrinks or may become glaucomatous with bulging of the sclerotic, total posterior synechia, secondary cataract.

Treatment.—1. When there is, as yet, neither sympathetic irritation nor sympathetic ophthalmitis, the injured eye must be watched as to the seat of its inflammation, and, if this is found to threaten the iris and ciliary region, precaution must be taken to do all that is possible to subdue it. Atropine should be applied. Patient kept in dark room for long period; eye bandaged. Mild mercurials and iodide of potassium internally.

2. If irritation is set up, the foregoing remedies to be applied to *both* eyes, and if the exciting eye is past hope of recovery it should be *excised at once.*

3. If ophthalmitis is established and exciting eye *quite blind* it should be excised at once; but if any useful sight remains it should be saved, as it may prove the better eye in the end.

In the latter case do all you can to save both the exciting and the sympathizing eye. (1) Use atropine drops every few hours; (2) rest the eyes by exclusion of light; (3) apply leeches, blisters, warm fomentations, etc.; (4) give mercurials.

Do not perform any operation on the eye until inflammation has subsided.

Conjunctiva.—Ophthalmia.—This term is applied to all forms of conjunctivitis. Chief forms are—1, *Purulent;* 2, *Muco-purulent;* 3, *Membranous;* 4, *Granular.*

Purulent Ophthalmia is generally due to contact with pus from the urethra or vagina, which may be gonorrhœal or otherwise. The *quality* of the infecting discharge greatly influences the nature of the ophthalmia. When caused by *gonorrhœa* the course is very violent. When occurring in newly born children it is called O. neonatorum.

Symptoms.—In from twelve to forty-eight hours after infection there are itching and slight injection of the conjunctiva, these soon become intense; then chemosis, tense swelling of the lids, great pain and discharge, at first serous, then turbid, then uniformly purulent. If untreated the discharge ceases in about six weeks, leaving the palpebral conjunctiva thickened, relaxed, and more or less granular. Cicatricial changes follow. The cornea is in danger from two chief causes, viz.: (1) strangulation of the vessels from pressure, and (2) the influence of the discharge. If within the first few days the cornea be hazy and dull, it may partly or entirely slough. In milder cases transparent ulcers may appear and sometimes cause perforation. In many cases no corneal opacity occurs.

Treatment.—When one eye only is affected, carefully protect the other by a watch-glass strapped on. Frequently and thoroughly remove the discharge by free douching with water. Use astringent or caustic lotions or drops every hour in severe cases, *e.g.*, lotio aluminis, gr. x. ad ℥ j.; lotio zinci, gr. x. ad ℥ j.; lotio hydrarg. perchlor., gr. ½ ad ℥ j.; lotio argent. nit., gr. ij. ad ℥ j. Apply simple ointment to the eyelids to prevent adhesion. Evert the lids and brush a strong solution of nitrate of silver (gr. x. or xx. ad ℥ j.) freely over the conjunctiva once daily, and well wash off immediately afterward either with water or with solution of common salt. Repeat less frequently as the discharge diminishes. In cases where the lids are so swollen that nothing can be applied to their conjunctival surfaces, the outer canthus can be divided, or Mr. Critchett's method of dividing the upper lid by a vertical incision can be adopted.

Treatment should be continued as long as any discharge or granulations remain on the lids, for fear of a relapse which is apt to occur.

Muco-purulent Ophthalmia (Catarrhal Ophthalmia).—Very common, very contagious, mostly attacks both eyes, differs in severity in members of the same household, who are generally attacked at the same time. *Symptoms.*—Congestion of conjunctiva, with patches of ecchymosis. Gritty pain, sometimes severe. Spasm of lids. Free muco-purulent discharge. Lids somewhat swollen and red, never tense. The cornea seldom suffers. Spontaneous recovery takes place in about two weeks. *Treatment.*—Any mild astringent lotion or drops will cut the malady short. An outbreak of this malady in a crowded community is serious. Very common in pauper schools.

Membranous Ophthalmia (Diphtheritic Ophthalmia).—Very rare in this country, and must not be confused with muco-purulent or purulent ophthalmia, in which there is often a distinct layer of inspissated pus beneath the lids. In membranous ophthalmia the whole thickness of the conjunctiva is occupied by a solid exudation, which is called "diphtheritic" by some surgeons. It may appear in patches, or may cover all the whole inside of the lids.

Granular Ophthalmia.—Very common. *Symptoms.*—Firstly, appearance as of small granules like sago-grains on the inner surface of the lower lid, due to inflamed lymphatic follicles. These extend to upper lid; then progressive changes in the palpebral conjunctiva in which it becomes thickened, vascular, and roughened by granular elevations. New tissue is formed in the deep parts of the conjunctiva, which afterward is partly absorbed, and partly undergoes cicatricial contraction. *Causes.*—Feeble health. Prolonged residence in badly-ventilated dwellings. *Treatment.*—Generally tedious. Evert the eyelids and apply a solution of nitrate of silver (gr. xx. ad ℥ j.) with camel's-hair brush, once, twice, or thrice a week; or apply the mitigated nitrate of silver stick; in each case wash the lids with water before inverting them. Solid sulphate of copper may be used instead of these. Glycerine of tannin applied daily is beneficial. *Results.*—(1) Haziness of cornea; (2) Pannus (see cornea); (3) Entropion, Trichiasis.

Xerophthalmia (Xerosis, Cuticlar Conjunctiva) is a condition of excessive dryness of the ocular and palpebral conjunctivæ.

Pterygium is a triangular patch of thickened conjunctiva, generally placed opposite the palpebral fissure, its apex pointing to or encroaching upon the cornea. Rare in this country. *Treatment.*—Dissect up from apex and transplant it into a cleft below the cornea. This is said to be more effectual than excision or ligature.

Pinguecula, a harmless patch of yellowish white thickened conjunctiva situated near margin of cornea.

Lupus may occur on conjunctiva.

Warts are sometimes seen on the ocular and palpebral conjunctivæ; they are cauliflower excrescences. To be snipped off with scissors.

Epithelioma and *Sarcoma* may occur on the conjunctiva.

Cornea.—*Inflammation* of the cornea may be circumscribed or diffused, may involve its proper layers, or may be confined to its anterior or posterior epithelial layer. It may be *local*, leading generally to suppuration or ulceration, or it may arise from *constitutional* disease, as inherited syphilis. It may exist with other inflammations, as in kerato-iritis, cyclo-iritis.

Local Keratitis (Corneitis).—*Symptoms.*—Commences with a more or less perfect zone of pinkish-red vessels around the margin of the cornea. Photophobia more or less severe. Cornea becomes hazy, and has a steamy or ground-glass appearance. Generally there is lachrymation, and frequently pain in and around the eye. *Pathology.*—The intercellular substance becomes opaque from infiltration with leucocytes, which are supposed to have emigrated from the surrounding vessels. The cells of the corneal tissue proper also undergo proliferation into small corpuscles, greatly resembling leucocytes. The disease often has a tendency toward recovery, but more frequently leads to suppuration and ulceration.

Ulceration of Cornea is preceded by inflammatory infiltration, and the inflamed part breaks down at the centre, forming an ulcer with more or less infiltrated base and edges. *Symptoms.*—Photophobia, congestion more or less, consisting of a circular zone of vessels beneath the conjunctiva at periphery of cornea, and *sometimes* also of conjunctival vessels. Pain sometimes acute,

Ulcers may be (1) *small and central, with* infiltration of base and edges. These generally heal quickly, but leave a hazy (nebula) or an opaque spot (leucoma).

2. *Small and central, without* much infiltration. These heal slowly and with loss of tissue, perhaps without opacity, but give a *facetted* appearance to the cornea.

3. *Phlyctenular ulcers* (Herpes corneæ).

4. *Serpiginous ulcers.*

5. *Acute suppurating ulcer* following abscess or otherwise. *Treatment.*—First secure rest, either by bandaging the affected eye, and so reducing friction against eyelids, or by shading both eyes. Soothe local pain by atropine drops. In suppurating cases apply hot fomentations to lids; if abscess is defined, open by valvular incision. When indolent, stimulate ulcer by astringent drops, ointment of yellow oxide of mercury, calomel powder, eserine drops (gr. iij. ad. ℥ j.), etc.

Counter-irritants to temple, as *seton* or *blister*. Constitutional treatment.

Hypopion signifies a collection of pus or purolymph in the lowest part of the anterior chamber. The pus is derived (1) from the rupture of an abscess through the posterior layer of the cornea; (2) from suppuration of the epitheloid layer covering Descemets' membrane; (3) from surface of iris.

Onyx is a term applied to that condition in which pus is observed between the layers of the cornea at its lower part.

Syphilitic Keratitis (Interstitial K. Parenchymatous K.).—*Symptoms.*—The visible changes of the cornea are usually preceded for a few days by some ciliary congestion and lachrymation; then there is cloudiness in one or more patches, and after a few weeks a ground-glass appearance. Frequently accompanied by iritis and posterior synechiæ. Blood-vessels often appear in the layers of the cornea, extending from the ciliary vessels; they are thickly set in patches (salmon patches) of a reddish pink color, and of various shapes; they may extend all over the cornea, except, perhaps, to the immediate centre. The disease is always symmetrical (contrast with local keratitis), but second eye is usually attacked a few weeks after the first. Age generally between six and fifteen. Often accompanied by inflammation of the ciliary region and iris, *which may* give rise to secondary glaucoma, to stretching and elongation of the globe in the ciliary zone, or to softening of the eyeball; but, *as a rule*, the cornea throughout its whole structure undergoes a chronic inflammation, showing no tendency either to suppuration or ulceration, the inflammatory products being partially or entirely absorbed after several months. *Cause.*—Inherited syphilis. Other signs of inherited syphilis are usually present. (*See* Congenital Syphilis.)

If no other signs are shown in the patient, a history of infantile syphilis can generally be ascertained, either in the patient or his brothers and sisters; or a history of acquired syphilis in the parents may be traced. A few cases have been seen in which this disease has occurred as the result of acquired syphilis.

Treatment.—A long but mild course of mercury. Mercurial inunction, gray powder, blue pill, etc. Iodide of potassium may be combined with these. Keep a strict watch against salivation. If the patient be anæmic or strumous, give iodide of iron, bark, quinine, etc. Keep the eyes shaded. Use atropine drops daily, as iritis may occur without being detected through the opaque cornea. When inflammation has subsided, apply calomel powder or ointment of yellow oxide of mercury to the cornea daily, in order to promote the absorption of the opacity.

Keratitis Punctata is characterized by the presence of small dots of opacity on the posterior elastic lamina of the cornea. They are generally arranged in the form of a triangle, having its apex at the centre, and its base toward the lower margin of the cornea. This condition is generally secondary to some form of inflammation of iris. It is frequently seen in sympathetic ophthalmitis.

Arcus senilis is caused by fatty degeneration of the corneal tissue just within its margin.

Pannus is the result of friction from a granular condition of the upper lid, trichiasis, etc. It is characterized by haziness of the cornea, with vascularity, the vessels being continuous with those of the conjunctiva, and the anterior layers of the cornea more or less infiltrated with plastic matter. *Treatment.*—1. Try to cure the granular lids. 2. The operation of *syndectomy* or *peritomy*—that is, the removal of a zone of conjunctival and sub-conjunctival tissue from around the cornea—is strongly recommended by Mr. Critchett in old intractable cases of pannus. 3. Very severe and universal pannus is best treated by *inoculation* with pus from purulent ophthalmia, or even from gonorrhœal discharge. It is a severe remedy, and may be followed by sloughing of cornea. It should *never* be resorted to if there is any portion of the cornea transparent.

Conical Cornea is caused by a bulging forward of the central part of the cornea forming a blunt conical curve, which gives rise to irregular astigmatism and myopia. In advanced cases the protrusion of the cornea is very evident, and the apex of the cone may become nebulous. In some cases vision may be improved by concave glasses in combination with a screen having a narrow slit or small hole in it. In advanced cases operation is needed: (1) Graefe's. Shave off apex without entering anterior chamber, then apply mitigated nitrate of silver stick to the raw surface to cause ulceration and cicatrization. (2) Cut off apex with a cataract knife, enter anterior chamber, leave wound to unite by itself or use sutures; use atropine drops.

Wounds of Cornea.—When penetrating, if iris is prolapsed push it back with a blunt instrument, and order atropine drops; if iris not protruding, order atropine drops. If only abraded, still order atropine drops. Close the eye with a bandage to prevent friction.

Eyelids.—Blepharitis, Stye, Tarsal Tumors, Warty Growths, Molluscum Contagiosum, Ulcers, Rodent Ulcer, Ptosis, Ectropion, Entropion, Symblepharon.

Blepharitis (tinea tarsi, ophthalmia tarsi, sycosis tarsi) is an inflammatory condition of the edges of the eyelid, which commonly attacks the glands and the follicles of the eyelashes. It varies in degree from mere congestion, with a sticky exudation, to chronic or subacute inflammation, with thickening of the tissues, excoriations, and even pustules. *Treatment.*—(1) Keep the eyelids clean and free from scabs by bathing twice daily with warm water or warm alkaline lotion. (2) Apply dilute nitrate of mercury ointment twice daily; in severe cases pull out the lashes with epilation forceps, and apply nitrate of silver to the edges of the lids.

Stye (hordelum) is a small furunculus at the margin of the lid, often very painful. Successive crops very common. *Treatment.*—Foment with warm water, apply bread-and-water poultice; puncture with a sharp lancet as soon as pointing has commenced.

Tarsal Tumor (meibomian cyst, chalazion), a chronic hypertrophy of a meibomian gland, occurs as a small hard nodule from 1–4 mm. in diameter in upper or lower lids; one or more may appear at the same time. The skin is freely movable over the tumor, which is hard, and not painful. If left alone it generally causes thinning of the conjunctival tissue, or it may point through the surface. *Treatment.*—Evert the lid and remove by incision from the conjunctival surface. When it points outward it is better to remove through the skin by incision parallel to margin of eyelid. When thus thoroughly removed it does not recur. When only incised it may remain for some time.

Warty Growths occasionally appear on edges of lid. Remove freely with scissors.

Molluscum Contagiosum often appears in region of eyelids. Consists of one or more hemispherical elevations of from one to six mm. in diameter, containing sebaceous material. *Treatment.*—Divide each little tumor by vertical incision, and squeeze out the contents by means of the thumb-nails applied to the bases of each.

Rodent Ulcer (epithelial cancer, rodent cancer) begins as a slight elevation near margin of eyelid; this is followed by a shallow ulcer with slightly indurated edges, and generally a brownish incrustation. Mostly occurs in persons over forty. Progresses slowly. Seldom cicatrizes. Attacks all surrounding tissues. Neighboring glands not enlarged. *Treatment.*—Remove all the diseased structure with the knife, or with the thermal cautery, as early as possible. In severe cases apply chloride of zinc paste in addition, after removal with the knife.

Syphilitic Ulcers are more acute, more punched out in appearance, have less indurated margins, and are more amenable to treatment than rodent ulcer.

Lupus generally occurs in younger subjects, and in other parts of the face. It is less indurated and more inflamed than rodent ulcer.

Nævus, often congenital, occasionally occurs on the eyelids, may be confined to the skin, or may involve subcutaneous tissue. *Treatment.*—1. By electrolysis. 2. By subcutaneous ligature. 3. By galvano-puncture.

Ptosis is partial or complete closure of the upper eyelid. Causes, various. May be congenital and due to non-development of the levator palpebræ superioris muscle. May be due to paralysis of the third nerve, which supplies that muscle. May be the result of injury to that muscle.

Treatment varies with cause. Graefe's operation; make incision through skin three lines above the margin of upper lid, and extending through its whole length, and expose the orbicularis palpebrarum muscle; seize the muscle with forceps, excise a portion about five lines in width. In bringing edges of skin together pass the suture through the cut edges of the muscle.

Trichiasis, ingrowing of the eyelashes, causing irritation of the globe. Frequently caused by contraction of the tissues after granular lids and after the application of caustics to inside of lids. *Treatment.*—If only a few lashes are turning in, these may be removed with epilation forceps. If many exist, then excision of the hair-bulbs should be performed as follows: Fix the lid by means of compressorium forceps. Make two incisions along the margin of the lid, one on each side of the row of eyelashes. Cut deeply, unite the incisions at each end, and remove the piece with scissors. Sutures not required.

Symblepharon is union of the palpebral and ocular conjunctivæ or of the margins of the eyelids. Caused generally by burns, as with molten lead, or caustic, as quicklime. *Treatment.*—1. When the edges of only the lids are united, or when a probe can be passed beneath the united conjunctivæ; (*a*) simply divide adhesions with knife, and keep the parts separated by means of oiled lint; (*b*) pass a strong silk ligature beneath the bands, and tie tightly, allowing the ligature to come away by itself. 2. When no probe can be passed beneath the adhesions, the results of operation are less satisfactory. Separate the parts by incision, and then dissect up the conjunctiva on both sides, and endeavor to bring the flaps thus formed over the raw surface by means of very fine silk sutures; still keep the ocular and palpebral portions apart by oiled lint.

Entropion.—Inversion of the eyelids, generally caused by cicatrices after caustics such as lime or nitrate of silver, or after injury. *Treatment.*—When very severe, and the conjunctiva is much contracted, remove the whole row of eyelashes as recommended for trichiasis. When less severe, perform Streatfeild's operation of grooving the cartilage.

Ectropion.—Eversion of the eyelid; may be partial or entire. *Causes.*—Contraction after injury or inflammation of the parts of the eyelid which are external to the tarsal cartilage; or contraction of cicatrices of the face following burns, lupus, etc. *Treatment.*—Try to prevent the progress of eversion by skin-grafting on to wounds of face. When permanently established try a plastic operation.

Glaucoma is so called from the occasional greenish appearance of the pupillary area. The pathognomonic symptom in all cases of glaucoma is increased hardness or "tension" of the eyeball.

Classification.—1, *Acute;* 2, *chronic;* 3, *secondary.*

Acute Glaucoma.—*Early Symptoms.*—Increased tension. Rapidly increasing presbyopia. Periodic dimness of sight. Halos or "rainbows" around the candle or other lights. Diminution of the field of vision.

Later Symptoms.—Acute pain. Congestion of conjunctiva, and of ciliary region. Dilated and sluggish pupil. Rapid impairment of vision. Tension of globe much above normal, T + 1 to T + 3 or T + 4. There may be turbidity of the vitreous obscuring the fundus, otherwise the *ophthalmoscope* reveals—1, cupping of the whole of optic discs, the edges being abrupt; 2, probably pulsation of the retinal vessels; 3, tortuosity of the veins; 4, small hemorrhages occasionally.

Chronic Glaucoma presents the same symptoms as the acute form, but in a modified degree. The tension of the globe is above normal, T + ½ to T + 1 or T + 2, but the increase of tension is less rapid. The pain is much less, and may be absent altogether.

Secondary Glaucoma is so called when occurring as a result or complication of some other disease or injury of the eye, as iridochoroiditis, needle operation, etc. It is a very grave symptom.

Pathology.—What is the cause of the increased tension? Theory 1. Active contraction of the sclerotic. 2. Excess of fluids of eye from increased supply of blood. 3. *Defective removal* of fluids from eye.

The region of the ciliary body is generally found to have undergone great changes. It becomes shrunken to half its natural size, its muscular fibres are atrophied and sclerosed. The base of the iris is found to be closely applied to the marginal part of the cornea. The ciliary arteries are enlarged. The changes are supposed to impede the escape of fluid from the anterior chamber, and perhaps from the vitreous also. The glaucoma cup is caused by pressure from within. The lamina cribrosa which forms the floor of the optic disc, being the weakest part of the capsule of the eye, slowly yields, becomes depressed and hollowed out, causing atrophy.

Treatment for Acute Glaucoma.—Perform iridectomy without delay. (1) Make incision partly in cornea and partly in sclerotic. (2) Make wound large enough to allow of exit of one-fifth of iris. (3) Remove iris quite up to its ciliary attachment.

Apply leeches to eye, and warmth: give purgatives and derivatives internally.

In Chronic Glaucoma.—First try action of eserine drops, with local depletion, and calomel and opium internally. If tension *continues to increase* perform iridectomy as in acute cases.

Sclerotomy, by similar incision to that of the scleral iridectomy, but without removing a portion of iris, is sometimes practised. Trephining the sclerotic behind the ciliary region has also been introduced, but these are both less efficient than iridectomy.

Iris.—Iritis.—*Causes.*—Syphilis. Rheumatism. Inflamed or ulcerated cornea. Injuries as in operation for cataract.

Symptoms.—(1) Change in color; (2) change in mobility; (3) change in vascularity; (4) pain; (5) impairment of vision; (6) photophobia and lachrymation.

(1) *Change in color* is due to congestion, and to effusion of lymph and serum into the texture of iris, as well as, in part, to turbidity of aqueous. It looks blurred and "muddy."

(2) *Change in mobility* is indicated by the pupil not responding actively to light, but becoming sluggish or quite inactive. The iris becomes more or less adherent by its posterior surface to the capsule of lens, constituting partial or complete *posterior synechia;* when *partial* the pupillary margin becomes jagged under atropine; when complete, the pupil cannot be dilated by mydriatics. When exudation of a layer of lymph takes place into the pupillary area the condition is termed "occlusion."

When margin of pupil is adherent to lens capsule by its whole circumference the condition is termed "exclusion."

(3) *Increase of vascularity* in the ciliary zone, around the margin of the cornea, generally occurs early, and the conjunctival vessels are generally congested.

(4) *Pain* of a neuralgic character in and around the eye, variable in degree.

(5) *Impairment of vision* is always more or less marked, may be owing to turbidity of aqueous, exudation of lymph on capsule in the pupillary area, impairment of accommodation by extension of inflammation to the ciliary body.

(6) *Photophobia and lachrymation* may or may not be present.

In *Syphilitic Iritis*, which only occurs in secondary syphilis, there is tendency to effusion of lymph, and formation of nodules in the structure of the iris. It seldom relapses; it is often symmetrical; pain not generally severe.

In *Rheumatic Iritis* there is little tendency to effusion of lymph, nodules never formed, generally unsymmetrical, although both eyes may suffer in turns; frequently relapses at intervals of months or years; congestion and pain often severe; sight not much affected.

Treatment.—(1) Use atropine drops (atropiæ sulph., gr. ij. ad. ℥ j.) three times daily to prevent adhesions, or to break down those which may have recently formed, also to relieve pain and congestion.

(2) If pain and congestion be severe apply leeches to temple, malar eminence, or septum nasi; repeat if necessary; apply blister to temple; avoid stimulants.

(3) For syphilitic iritis employ the treatment proper for secondary syphilis. For rheumatic iritis give alkalies, iodide of potassium, colchicum.

(4) Rest the eyes; all eye work to be discontinued; order a shade for both eyes; darken the room, or bandage the affected eye with a pad of cotton-wool, especially in rheumatic cases.

(5) Iridectomy should be performed (1) in those cases in which judicious local and internal treatment have been tried for several weeks without benefit; (2) where adhesions exist and attacks are recurrent; (3) when there is complete exclusion of the pupil.

Operation of Iridectomy.—(1) Separate lids by a spring-stop speculum. (2) With lance-shaped knife incise sclerotic one line from corneal margin, and let the point enter anterior chamber just in front of iris, keeping point well forward to avoid wounding the lens. (3) Introduce iris forceps through wound, and seize iris near pupillary margin; draw this out through wound and cut off with fine scissors.

Artificial Pupil is mostly made by (1) iridectomy; but for cases in which this is unsuitable one of the following methods may be adopted: (2) by using a broad needle and hook; (3) by iridodesis, or ligature of iris (Critchett's operation); (4) by division of iris with Wecker's scissors introduced into anterior chamber (iridotomy).

Prolapse of Iris generally follows penetrating and incised wounds of cornea. *Treatment.*—(1) By removal of prolapsed portion with fine scissors. (2) By compress applied externally over closed lids. (3) By frequent puncturings of the prolapsed iris with a fine needle. In either of these methods a soothing treatment should be adopted. Atropine drops three times daily; bathing with belladonna lotion. After some days a shade should be worn, and the eyes carefully watched.

Coredialysis is a partial detachment of the iris from its ciliary border, forming a second pupil. It is generally caused by a sharp blow. Congenital irideremia (absence of iris) is occasionally seen.

Coloboma of the Iris (congenital cleft) appears like a very regular result of iridectomy downward, or downward and inward; usually symmetrical; variable in degree; generally associated with a corresponding defect in the choroid.

Mydriasis (dilatation of the pupil) is a derangement which may be caused by disease or by the action of mydriatic drugs, *e.g.*, glaucomatous tension of the globe, diseases of choroid or retina, optic atrophy, paralysis of third nerve. *Mydriatics*, sulphate of atropia, extract of belladonna, sulphate of duboisine, sulphate of daturine, etc.

Myosis (contraction of pupil) may be caused by spasmodic action of the circular fibres of iris, loss of power of radiating fibres of iris, hyperæsthesia of retina, affection of spino-sympathetic filaments which supply the radiating fibres of iris, myotic drugs, *e.g.*, Calabar bean, sulphate of eserine, nitrate of pilocarpine.

Lachrymal Apparatus.—Overflow of tears (lachrymation, epiphora, stillicidium) is caused by excessive secretion, or by some defect in the lachrymal apparatus which prevents the escape of the tears. This defect may exist (1) at the punctal achrymalia, which may be displaced or obstructed; (2) in the canaliculi, which may be obstructed by stricture near the sac or by foreign body; (3) in the lachrymal sac or nasal duct.

Inflammation of the Lachrymal Sac is very common; generally caused

by *stricture of the nasal duct. Symptoms.*—Lachrymation, presence of a tumor (mucocele) at the inner canthus, which may often be emptied by pressure with the finger, the contents passing upward through canaliculi, or downward through nasal duct. The contents of the sac vary according to the character of the inflammation. At first it consists of viscid mucus, which may remain a long time, or may become semi-purulent; in more acute inflammation there is abundant suppuration with swelling of surrounding parts, and pointing either through the skin, when a lachrymal fistula is established, or through the conjunctiva near the caruncle. *Treatment.*—1. Slit up the canaliculus, and so give free exit to contents of sac. This may be done upon Critchett's director, or by passing a Weber's canaliculus knife, or by a pair of delicate scissors. 2. Endeavor to cure the stricture of the nasal duct by passing a lachrymal probe every third day until lachrymation ceases. Various kinds of lachrymal probes are used, as Bowman's, Couper's, Weber's.

Fistula of lachrymal sac frequently occurs in acute inflammation—a small tortuous sinus between the sac and the skin, from which a continuous oozing of the tears on to the cheek takes place. *Treatment.*—(1) Cure the stricture and restore the mucous membrane to a healthy condition. (2) If necessary, pare the edges of fistulous opening, and bring together by fine suture.

Lachrymal Gland.—Hypertrophy, acute and chronic inflammation, abscess, fistula, cysts, sarcoma. *Removal* sometimes required for disease or for obstinate cases of lachrymation. *Operation.*—Make incision below upper and outer third of the orbital ridge through skin and the fascia: feel for gland with finger, seize with hooked forceps, draw forward, sever with knife, do not close wound till hemorrhage has ceased.

Optic Nerve.—Diseases: Neuritis; Atrophy.

Optic Neuritis may extend from the brain to the retina (descending); may commence at the optic disc (papillitis) and thence pass along the nerve (ascending). When the disc is affected there may be (*a*) simple congestion; (*b*) congestion with swelling, which renders the outline of the disc more or less obscure. *Causes.*—Cerebral tumor, meningitis, syphilis, albuminuria, lead-poison, wound of cornea, hypermetropia. The sight is affected in proportion to the change in the optic nerve fibres. There may be lessened acuteness of vision, limitation of field of vision, altered color perception. *Treatment.*—Endeavor to find the cause of the malady and treat this. Rest the eyes. In cases where syphilis is a known cause, give a prolonged but mild course of mercury and iodide of potassium. When syphilis is the probable cause, give iodide, and in the early stage give mercury also. In strumous cases, pursue tonic treatment.

Atrophy of Optic Nerve may commence without any visible inflammation of disc (primary), or may follow as a result of papillitis. The optic disc varies in appearance from slight pallor to bluish-white. The vessels

may be of normal size, or may be much atrophied. *Treatment.*—Give quinine and iron internally. Phosphorus, nitrate of silver and strychnine are each sometimes employed. Try the interrupted voltaic current.

Retina.—The healthy human retina is so transparent during life that it is hardly seen with the ophthalmoscope. The vessels of the retina are seen radiating from the optic disc. Inflammatory and other deposits in the retina are also seen when present. The chief diseases of the retina are, Hyperæmia, Retinitis, Detachment, Embolism of the Central Artery, Glioma, Cysts.

Hyperæmia.—Generally caused by overwork, especially if patient be ametropic. Fundus looks too red, and optic disc has a pinkish, flushed appearance. *Treatment.*—Functional rest, local depletion by leeches or blister if necessary. Correction of ametropia by use of spectacles.

Retinitis.—(a) *Syphilitic;* (b) *albuminuric;* (c) *apoplectic;* (d) *pigmented.*

Syphilitic Retinitis.—One of the many secondary symptoms of syphilis—generally occurring between six and eighteen months after infection—occurs in inherited as well as in acquired syphilis. Ophthalmoscope shows a grayish white haze around optic disc, patches of yellowish white exudation over the fundus, generally more or less choroiditis, generally more or less turbidity of vitreous. *Treatment.*—Functional rest of eyes, general treatment for secondary syphilis.

Albuminuric Retinitis (Nephritic R.) may come on gradually with the advance of kidney disease; may be dependent on uræmia and occur in the later stages of kidney disease. May be caused by temporary albuminuria, as in that which occasionally occurs during pregnancy. In early stage sight may be unaffected. Ophthalmoscope shows a dull gray haze in central region of retina due to œdema, generally a few small patches of hemorrhage scattered over fundus. Optic disc may be also swollen. In advanced stage sight greatly affected in one or both eyes. Central region occupied by numerous dots, spots, or patches of an opaque white substance grouped around the yellow spot. Hemorrhages are frequent, and usually have a striated appearance. Optic nerve sometimes inflamed (neuroretinitis). Prognosis must be guarded. Treat disease of kidneys. Rest and protect eyes by cobalt-blue glasses.

Retinitis Apoplectica.—From sudden hemorrhage from a retinal vessel, from disease of vessels, or of heart.

Retinitis Pigmentosa.—Characterized by a peculiar deposit of dark pigment—varying in pattern—usually commences at the periphery of the fundus, and gradually approaches the centre. Optic disc of a pale yellow color. Often associated with posterior polar cataract. Often occurs in several members of the same family. *Prognosis* bad. May remain stationary. May go on from bad to worse.

Detachment of Retina may be partial or entire. Causes: (a) *elonga-*

tion of coats of eyeball as in extreme myopia; (b) *diminution of vitreous;* (c) *hemorrhage* or serous exudation between retina and choroid; (d) *tumors of choroid. Symptoms.*—By direct examination the detached portion appears as a bluish-gray film bounded by a sharp line. The vessels traced from disc give a sudden bend at the line of detachment. The detached portion is seen to be pushed forward, and the vessels upon it are tortuous, small, and of dark color. The field of vision is limited. *Prognosis* is unfavorable.

Glioma, a small round-celled growth proceeding from the granular layers of the retina, occurring generally in very young children. It is seen as a glistening white substance at the bottom of the eye, and if allowed to remain, it rapidly spreads along optic nerve to the brain, and to the surrounding structures within the orbit. Secondary deposits may occur. *Treatment.*—Early excision of globe.

Refraction of the eye signifies the influence exercised by the transparent media upon rays of light entering it.

Emmetropia signifies normal refraction.

Ametropia signifies abnormal refraction, and may be divided into (1) *myopia;* (2) *hypermetropia;* (3) *astigmatism.*

Emmetropia is that condition of refraction in which rays from distant objects, and which are practically parallel, come to a focus upon the retina when the eye is at rest, that is, when accommodation is relaxed. The *Emmetropic* eye cannot see *near* objects without increasing the convexity of the crystalline lens, because the rays from near objects are divergent, and would therefore focus behind the retina. This change of shape in the lens is effected by the ciliary muscle, and is called *accommodation.*

The farthest distance of distinct vision in any state of refraction is called the *far-point,* the shortest distance of distinct vision is the *near-point.* The *near-point* and the *far-point* are found by means of test types. Those of Snellen and Jæger are in common use. The distance between the near-point and the far-point is called the *range* or amplitude of *accommodation.* It is the distance over which the eye has command by means of its accommodation.

Accommodation, as we have seen, depends upon the contractility of the ciliary muscle, and upon the elasticity of the crystalline lens. Now, as age advances, the ciliary muscle gradually loses its contractility, and the lens its elasticity. So that in emmetropia the near-point gradually recedes from the eye. This recession commences at about the age of ten. Thus at the age of ten years the amplitude of accommodation is equal to a lens of 14 D, and the distance of the near-point from the eye is 7 centimetres; at fifteen years the distance is 8 ctm.; at twenty years it is 10 ctm.; at thirty years it is 14 ctm.; at forty years it is 22 ctm.; at fifty years it is 40.5 cm.

The emmetropic eye, therefore, can read No. 6 of Snellen's test types

at the distance of six metres without the aid of either convex or concave lenses ($V=\frac{6}{6}$) at *all ages.* It can read No. 1 of Snellen's test-types for reading as near as 7 centimetres up to the tenth year of age, but after that time there is a gradual recession of this near-point. At the age of forty years the near-point is 22 ctm.

Presbyopia (Old Sight) is that condition in which the near-point has so far receded as to cause discomfort in reading and fine work. This distance is about 22 ctm. (8 inches). In the *normal eye* this distance (*see* Emmetropia) is reached at about forty years, so that after that age all fine work, such as reading, needlework, etc., must be held at more than 22 ctm. from the eye. This inconvenience is easily overcome by prescribing convex lenses to be worn for reading and fine work. The following table will show the strength of the lens required by the normal eye at different ages, to correct for presbyopia:

Age.	Strength of Spherical Convex Lens in Dioptres.
40	0
45	1
50	2
55	3
60	4
65	4.5
70	5.5
75	6
80	7

In *hypermetropia* presbyopia comes on earlier than in emmetropia, because the hypermetropia has to be neutralized before any accommodation is available for near vision. Thus, suppose a hypermetrope of 2 dioptres, what strength of lens would be required to correct his near vision at the age of fifty? He will require first 2 D to correct the hypermetropia, and, by the above table, we see that 2 D would be the strength required if he were emmetropic. Therefore, $2+2=4$D, or let x be the amount of hypermetropia expressed in dioptres, and x' the strength of lens required according to age, then x D$+x'$ D will be the strength of the spectacles required for near vision. In *myopia* presbyopia comes on later than in emmetropia, because for the same amount of accommodation the near-point is always nearer than in the normal eye. In very high degrees of myopia (over 4.5 dioptres) the patient will never become so presbyopic as to require convex glasses for near vision, because in a state of repose the eyes are adapted for a shorter distance than 22 ctm. He may, however, require concave glasses for *near* as well as for *distant* vision (*see* Myopia). Suppose a myope of 3 D, sixty years old, what spectacles would he require? We see by the

table that, if emmetropic, he would require 4 D, and we know that he has myopia $=-3$ D. Therefore $+4-3=+1$ D will be the strength of spectacles required for near vision.

Myopia (Short Sight) is that condition of refraction in which *parallel* rays come to a focus in front of the retina, the eye being at rest. *Symptoms.*—Patient cannot see distant objects clearly, and if told to read small print (No. 1 of Snellen's test types) will hold it within the distance of his far-point from the eye. Vision improved by concave spherical lenses, made worse by convex lenses. *Retinoscopy* reveals a shadow which passes in the same direction as the reflected light. *Ophthalmoscopy.*—1. By *direct examination* with mirror alone, image of vessels of fundus seen at distance from eye, and moves in the opposite direction to the observer's head when the latter is moved from side to side. 2. By *indirect examination*, the optic disc appears smaller than in emmetropia, and appears to increase in size on withdrawing the lens used. 3. By *direct examination*, when the instrument is held *close* to the patient's eye the retinal vessels, optic disc, and other details of the fundus cannot be clearly seen without the intervention of a concave lens, the strength of the lens required for this purpose being *a measure of the degree of myopia.* In many cases a crescentic patch of yellowish white appearance (*myopic crescent*) is seen on the outer side of the optic disc; this is caused by atrophy of the choroid. In high degrees of myopia other patches of choroidal atrophy are often seen. Choroidal hemorrhages and hemorrhages into vitreous occasionally occur. *Causes.*—Too great length of globe. Too great curvature of cornea. Too high refractive power of media of eye. Hereditary tendency. Prolonged use of eyes in looking at close objects. *Treatment.*—Having ascertained accurately the degree of myopia, order spectacles to be worn. 1. To give clear vision of object at a distance (No. 6 to 60 Snellen's at 6 metres). 2. To enable the patient to read small print (No. 1 Snellen) at the same distance as an emmetrope. In all cases of myopia below 6 or 7 dioptres, where the accommodation is good, the glasses which exactly correct the myopia should be used for near and for distant vision. They should be worn constantly. In most cases where the myopia is higher than 7 D, and in all cases where the *accommodation is feeble*, two kinds of spectacles must be worn: one pair for distance, equal in strength to the degree of myopia, another pair for near vision of lower power. The required strength of these is found in the following manner (Donders): *From the lens which exactly neutralizes the myopia deduct the strength of a lens whose focal length is equal to the distance at which we wish the patient to work.* Thus, suppose a myope of 10 D wishing to read No. 1 Snellen at 40 ctm. From 10 D deduct the lens whose focal length is 40 ctm., viz., 2.50 D; then $-10+2.50=-7.50$ D, and -7.50 D is the strength of spectacle required. In prescribing for patients over forty, proper allowance must be made for presbyopia (*see* Presbyopia).

Hypermetropia is that condition of refraction in which parallel rays come to a focus behind the retina—the eye being at rest.

Causes.—1. Most commonly the axis of the eye is too short. 2. The curvature of the cornea or of the surface of the lens may be insufficient. 3. The refractive index of the media may be too low. The disease is frequently hereditary.

Symptoms.—Since rays from a distant object (parallel rays) come to a focus *behind* the retina, it follows that rays from a near object (*divergent* rays) will be focussed still further *behind* the retina, and therefore a hypermetrope is unable to see anything clearly, either distant or near, without using *accommodation.* If therefore the *hypermetropia be slight*, and the accommodation powerful, there will be no inconvenience, either for near or distant vision. But if the *accommodation is failing*, as it always does from age, and as it frequently does from disease, the patient cannot see near objects for long together without aching pains or sense of fatigue in the eyes, combined with dimness of vision. In *high degrees* of hypermetropia the greater part of the accommodation is required for distant vision, and the patient is never able to see near objects clearly. The symptoms therefore vary with the degree, and become more manifest as age advances. Hypermetropia is frequently an indirect cause of squint (*see* Strabismus). The objective symptoms are as follows:

1. *Keratoscopy* reveals a shadow which passes in the opposite direction to that of the reflected light.

2. *Ophthalmoscopy.—Direct method* at a good distance from the eye shows the image of vessels of fundus, and this image moves in the same direction as the observer's head when the latter is moved from side to side.

Indirect method shows size of disc to diminish on withdrawing the lens from patient's eye.

Direct method.—When oblique mirror is used close to the patient's eye, and the accommodation both of patient and observer relaxed, no clear detail of fundus can be made out without the aid of a convex lens. The strength of the lens thus required to make quite clear the detail of fundus gives an exact *estimate of the degree of hypermetropia.*

3. *By means of Test-types and Test-glasses.*—See if patient can read Nos. 6 to 100 Snellen at 6 metres. Then, if he can read the same as well or better with a convex glass, the highest glass with which he gets the best vision is a measure of his *manifest* hypermetropia. In children, and in all cases where spasm of the ciliary muscle is suspected, it is necessary to paralyze the accommodation by atropine drops, in order to obtain the *latent* as well as the *manifest*, that is, the total hypermetropia.

Treatment.—Having found the degree of hypermetropia, order spectacles to be worn as follows: 1. In children and young adults order the constant use of glasses both for near and distant vision; the strength of these should be equal to all the manifest hypermetropia plus half the latent.

Patient may complain of inconvenience, but should persevere. 2. In persons over forty years of age order glasses as directed under Presbyopia (*see* PRESBYOPIA).

ASTIGMATISM is *Regular* or *Irregular*.

REGULAR ASTIGMATISM is that condition in which the refraction is different in different meridians of the same eye; the two principal meridians being always at right angles to each other.

IRREGULAR ASTIGMATISM is that condition in which there are different degrees of refraction in different parts of the various meridians. *Regular Astigmatism* may exist in five different forms.

1. *Simple Myopic.*—One meridian emmetropic, and the other myopic.

2. *Simple Hypermetropic.*—One meridian emmetropic, the other hypermetropic.

3. *Compound Myopic.*—Both meridians myopic, one more than the other.

4. *Compound Hypermetropic.*—Both meridians hypermetropic, one more than the other.

5. *Mixed.*—One meridian myopic, the other hypermetropic.

Causes.—Chiefly unequal curvature of cornea, perhaps irregularity of lens also. *Symptoms* vary with the *kind* and the *degree* of astigmatism. The lower forms often pass unheeded until rather late in life. The higher forms cause such fatigue and distress that the eyes are disqualified from prolonged exertion. Astigmatism must always be suspected when by testing with spherical lenses the patient cannot be made to read Nos. 6 or 9 Snellen at 6 metres (the fundus being otherwise healthy). When astigmatism is suspected, proceed to examine each eye carefully as follows:

1. *Retinoscopy.*—The intensity, direction, and velocity of shadow will indicate the *kind* of error in each meridian.

2. *Ophthalmoscopy.*—By indirect examination the optic disc appears *oval* instead of circular, and by withdrawing the mirror used away from the patient's eye the disc appears to change its shape. By direct examination, the mirror being held close to patient's eye, the vessels of the different meridians may be seen with lenses of different powers, the difference between the powers of the lenses thus used being an exact measure of the degree of astigmatism.

3. Place patient at distance of six metres from Snellen's test-types, and with spherical lenses correct the ametropia as far as possible. Then rotate in front of the correcting lens a stenopaic slit; by this means the two principal meridians will be found, and must be corrected seriatim. The difference of power between the lenses which correct these two meridians is an exact measure of the degree of astigmatism. The same object may be effected by the use of cylindrical glasses without the slit.

4. An excellent instrument for finding the two meridians is Tweedy's Optometer (see *Lancet*, October 28, 1876).

Whatever means be employed in diagnosis, *cylindrical* lenses should be prescribed which fully correct the astigmatism. The patient may not be able to see very much at first, but by the *continued use* of spectacles the vision will generally improve.

Strabismus (Squint).—The visual line is the axial line joining the centre of the object observed, with the centre of its image on the yellow spot of the retina. Deviation of the eye from the visual line, so that the image does not fall on the yellow spot, but on some other part of the retina, is called squint. This deviation may produce double vision—*diplopia*—when the image formed by the squinting is usually fainter than that of the other eye, and is called the *false* image. When the false image appears on the same side of the true image as the deviating eye, the diplopia is termed *homonymous*, when on the opposite side the diplopia is *crossed*. The greater the deviation of the eye the fainter the image appears, as it falls more upon the periphery of the fundus. Patients learn to disregard the false image, and so to use one eye at a time or one eye only. *Causes of Squint.*—(*a*) Ametropia; (*b*) affection of ocular muscles, as over-action, weakness, paralysis; (*c*) disuse of eye. Chief kinds are internal and external.

INTERNAL STRABISMUS (Convergent).—Very common, generally caused by hypermetropia. In hypermetropia the patient is obliged to use accommodation in order to see even distant objects. Now accommodation is always accompanied by convergence, and when a near object has to be seen, the accommodation and, consequently, the convergence used, are so great that the eyes deviate internal to the visual line, so that the image does not fall upon the yellow spot, and is therefore not distinct. Patient then fixes one eye upon the object, *i.e.*, causes it to move in the direction of the visual line whilst the other eye still deviates. The amount of deviation is measured by the distance between two vertical lines, one bisecting the pupil, the other bisecting the eyelids. *Diagnosis.*—In well-marked cases let patient look steadily at the tip of index finger placed about a foot in front of eyes, then screen each eye successively, and watch the eye thus screened. The squinting eye makes a decided movement toward the visual line when the working eye is covered, but the working remains quite stationary when the squinting is screened. In less marked cases the diagnosis is more difficult. Take patient into dark room and direct him to look steadily at lighted candle at distance of ten feet without moving his head. Place a piece of red glass in front of one eye, then if diplopia be present the image of this eye will be red and that of the other eye of normal color. The distance of these images apart and their relative position gives the character of the deviation—homonymous diplopia indicating convergent, and crossed diplopia indicating divergent strabismus. *Treatment.*—1. If the patient be hypermetropic, if squint be slight and of recent date, and if vision be good in both eyes, try the effect of well-fitting convex spectacles

for one or two months. 2. Perform TENOTOMY of the internal rectus of one or both eyes. Both eyes generally require to be operated on. *Operation.*—Separate lids by stop-speculum, let assistant turn eye outward by forceps, with toothed forceps pinch fold of conjunctiva between cornea and caruncle, with squint-scissors cut through this and through the capsule of Tenon, pass squint-hook beneath the tendon from below and cut it through between hook and globe, pass in the squint-hook a second time to be quite sure that the tendon is divided; suture for conjunctival wound is not generally used.

EXTERNAL STRABISMUS (Divergent) is the result of weakness of the internal rectus; commonest in myopia; occasionally occurs in hypermetropia; sometimes occurs in a blind eye; may follow tenotomy of internal rectus where too much subconjunctival tissue has been divided; common in partial or complete paralysis of the third nerve. *Diagnosis,* the same as for internal strabismus. *Treatment.*—If resulting from paralysis, try and find the cause of paralysis and treat this; if not from paralysis, perform tenotomy of the external rectus, and if necessary also, at the same sitting, perform the operation for *readjustment or advancement* of the internal rectus. This is done in various ways, and consists of separation of the muscle from its insertion into sclerotic, and bringing it further forward on sclerotic by means of sutures passed through the muscle and attached to conjunctiva close to cornea.

LIST OF WORKS CONSULTED IN THE FOREGOING NOTES.

Wecker and Landolt—"Traité Complet d'Ophthalmologie," 1879.
Wecker—"Chirurgie Oculaire."
Donders—"Anomalies of Accommodation and Refraction."
Pagenstecher and Geath—"Atlas of the Pathological Anatomy of the Eyeball."
Graefe and Saemisch—"Handbuch der Augenheilkunde."
Soelberg Wells—"Diseases of the Eye."
Nettleship—"Diseases of the Eye."
Lawson—"Diseases and Injuries of the Eye."
Brudenell Carter—"Diseases of the Eye.
Gowers—"Medical Ophthalmoscopy."
Streatfeild—Chapter on "Ophthalmic Surgery" in Erichsen's "Surgery."